DESIGN AND DEVELOPMENT OF OCCUPATIONAL CLOTHING FOR SANITATION WORKERS

Synopsis

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1.0. INTRODUCTION

Sanitation workers, commonly known as "safai karamcharis" in India, are tasked with collecting, transporting and disposing of solid waste, contributing to the cleanliness of public areas. Their vital role in upholding hygiene and cleanliness is evident in cities, towns and villages throughout the nation.

Sanitation workers, whether employed or not, are tasked with operating, maintaining, or emptying different sanitation technologies throughout the sanitation process. They are responsible for upkeep of toilets in various locations like homes, public spaces, and establishments. Moreover, sanitation workers are also involved in tasks such as emptying septic tanks and pits, cleaning manholes and sewers, as well as working in sewage and waste treatment facilities (Dalberg Advisors 2017; WHO 2018).

Sanitation workers play a crucial role in different aspects of the sanitation process, such as maintaining cleanliness in toilets and public areas, clearing and cleaning sewers, septic tanks, and drains, as well as managing sewage treatment facilities.

The sanitation work in India is physically demanding, frequently requiring exposure to unhygienic environments and possible health hazards. Regrettably, sanitation workers in India have long encountered difficult working conditions, such as insufficient safety gear, meagre wages and restricted healthcare access.

Sanitation workers in India play a crucial role in maintaining the cleanliness of our cities, even though their occupation is loaded with danger and unhygienic conditions. Unfortunately, their right to a safe working environment is often neglected. Moreover, the COVID-19 pandemic has further exacerbated their already precarious situation. Recent research studies have revealed that over 5 million sanitation workers carry out their duties on a daily basis across the country, with nearly 2 million of them engaged in the hazardous task of cleaning sewers and septic tanks (Gupta, 2022).

Sanitation workers frequently encounter human waste without any protective gear, putting them at risk of various health hazards and diseases. Their exposure to toxic gases like ammonia, carbon monoxide and sulphur dioxide in septic tanks and sewers can lead to loss of consciousness or fatalities. According to Nair (2018), an estimated three sanitation workers lose their lives every five days in India.

A recent study carried out by The Wire in 2021 revealed that sanitation workers have an average life expectancy of 40 to 45 years, which is considerably lower than the national average in India, standing

at 70 years. Moreover, these workers face a higher risk of prolonged illnesses and work-related fatalities. The report highlights that over the past five years; approximately 375 to 475 individuals engaged in manual waste collection have lost their lives on the job, primarily due to suffocation while cleaning sewers and septic tanks.

The officially recorded death rate may not accurately reflect the actual number of deaths, which could be much higher. Furthermore, workplace accidents only consider specific types of incidents occurring on site. Additionally, it is worth noting that some sanitation workers turn to drugs and alcohol as a means to deal with the overwhelming and unsustainable conditions they face. This further becomes a cause of fatality.

1.1. OCCUPATIONAL CLOTHING

Occupational attire, commonly referred to as workwear, is a specialized outfit donned by individuals across different occupations to carry out their job responsibilities in a secure and effective manner. Its purpose is to offer specific functionalities, including safeguarding against potential risks, distinguishing job roles and complying with industry regulations. Occupational attire encompasses a range of items, such as lab coats for scientists, high-visibility vests for construction workers, scrubs for healthcare professionals and uniforms for service industry employees. The design and materials utilized in occupational attire are customized to cater to the unique requirements of each job, aiming to enhance comfort, safety and productivity. Thus, occupational clothing plays a crucial role in ensuring the safety, professionalism and effectiveness of individuals in various industries or job profiles.

1.2. SIGNIFICANCE OF THE STUDY

Studies and review states that in India the sanitation workers face several health hazards due to the nature of their work. These hazards can have both immediate and long-term effects on their well-being. Some of the key health hazards faced by sanitation workers in India include: Exposure to Hazardous Chemicals and Substances, Contact with Infectious Materials, Physical Injuries, Respiratory Hazards, Ergonomic Hazards, Vector-Borne Diseases, Slips, Trips and falls, etc.

In a study conducted by Lenka (2020) in Bhubaneswar, it was found that a significant number of sanitation workers, out of a total of 232, reported not being accustomed to using any form of protective gear while carrying out their sanitation duties. Such a lack of protective gear has resulted in numerous

health-related issues and even accidental deaths among these workers. Shockingly, approximately 60% of the sanitation workers stated that they were not provided with any protective gear or equipment. Consequently, the absence of such gear leads to a multitude of health problems for the workers while they are on site. A few of the sanitation workers revealed that the government has not allocated any funds or equipment for sanitation workers since 2006. The sanitation budget primarily focuses on managing the sanitation work, with only minimal funds being allocated for protective equipment and gear. However, this data strongly emphasizes the importance of protective clothing for sanitation workers in order to minimize the risk of injuries or infections. Regrettably, in India, these workers face significant challenges in accessing adequate protective gear. Even if a few of them manage to obtain protective gear, it is often ineffective in providing sufficient protection and lacks basic comfort.

Providing sanitation workers with appropriate occupational clothing is not only a matter of ensuring their safety and well-being, but also, would contribute to a more efficient and professional workforce, benefiting both the workers and the community they serve.

Thus, the present study is directed towards developing a cost effective, ergonomically designed protective work-wear, which would be comfortable and non-restrictive for the sanitation workers. The title of the study hence emerges as **"Design and development of occupational clothing for sanitation workers".**

1.3. OBJECTIVES OF THE STUDY

The title is quite vast, hence to fulfil it a few objectives are framed which are given below.

- To understand the challenges related to health, safety, working conditions and livelihood faced by various categories of selected sanitation workers.
- To explore the regulatory guidelines, for sanitation workers in India and to study the available clothing in India and the western countries.
- To design and construct appropriate occupational clothing for male and female sanitation workers.
- To train SHG women to develop occupational clothing.
- To evaluate the effectiveness of the developed occupational clothing.
- To disseminate the knowledge among the sanitation workers and their governing bodies.

1.4. DELIMITATIONS OF THE STUDY

The study would limit itself, thus the delimitations of the study are given below:

- The proposed study will be conducted in a few districts of Uttar Pradesh only.
- The sample size will include only 300 sanitation workers, 20 middle/lower management and 5 top management individuals.
- The study will limit itself to designing clothing only. Sourcing of appropriate fabrics and accessories available in the Indian market will be done.

2. REVIEW OF LITERATURE

Reviewing involves thorough examination, analysis, assessment and of scholarly materials pertaining to a specific subject matter. A literature review critically assesses the key aspects of existing knowledge, including significant findings, theoretical contributions and methodological approaches related to a particular topic. In the context of the current study, the available literature is compiled based on various variables encompassed within this study. The review is categorized in areas such as, the occupational hazards faced by the sanitation workers, work environment, health hazards, physical hazards, chemical and biological hazards, biochemical and ergonomic hazards, psychosocial hazards and other challenges faced by the sanitation workers.

2.1. Review of Literature Based on Research Variables

Sanitation workers play a crucial role in waste management, however, they encounter a multitude of risks while carrying out their duties. It is imperative to highlight these risks and delve into the challenges that sanitation workers encounter. From being exposed to waste products to operating machinery that deals with sewage and wastewater, working in confined and hazardous spaces, and facing toxic gases, sanitation workers are susceptible to a range of occupational health hazards. Without adequate personal protective equipment, sanitation workers are at serious risk of harm, including fatal injuries, putting their lives and means of living in jeopardy.

2.1.1. Work Environment

Singh (2009) highlighted the diverse tasks carried out by sanitation workers, which include cleaning roads, sanitizing toilets, collecting garbage and working at disposal sites. These workers are regularly exposed to a variety of waste materials such as spoiled food, animal waste and hazardous gases, putting

them at risk of infections and viruses (Kumar, 2017).

Bhatnagar's article in “The Wire” on November 13, 2018, shed light on the challenges faced by sanitation workers in India. The data presented in the article revealed that out of the five million individuals employed in sanitation related roles in India, around two million work in hazardous environments. Despite government efforts like the Swachh Bharat Abhiyan, manual scavenging, a perilous form of sanitation work still persists in the country.

2.1.2. Health Hazards

According to Ghosh (2017), working in the sanitation field in India is unquestionably one of the most perilous occupations. Despite the absence of official data, independent studies indicate that there are at least 1370 fatalities each year in this field and this figure is significantly underestimated. The lack of safety measures and protective equipment has been well documented as the cause for up to 2% of workers losing their lives while carrying out their duties. These workers frequently suffer from severe health problems and have a reduced lifespan due to constant exposure to toxic fumes and the risk of diseases due to handling waste. Working in such hazardous environments can lead to conditions like trachoma, vomiting, diarrhoea, anaemia, skin infections, nausea and jaundice.

A survey of 214 sanitation workers across different locations in India conducted by Nigam and Dubey (2020) stated that a majority of sanitation workers faced lack of essential provisions such as tools, uniforms, emergency kits and health insurance. Also contractualization of sanitation jobs was more prevalent in tasks related to cleaning wet waste and toilets, compared to jobs focused solely on cleaning dry waste.

On 27th May 2020, Chakravorty penned an article titled 'India's sanitation workers: Unsung heroes battling Covid from the frontlines. This write up sheds light on the risks faced by India's 40 lakh waste pickers in the informal sector and garbage collectors employed by states, who were directly exposed to the coronavirus due to handling unmarked medical and contaminated waste.

Sanghavi (2020) in article dated November 22 of Times of India underscored the vital role of sanitation workers as the unseen warriors maintaining the cleanliness of our cities. The article referenced by the Accountability Initiative and Centre for Policy Research, report (2019), revealed a worrying decline in allocations to the Self Employment Scheme for Rehabilitation of Manual Scavengers (SRMS) since

2013. It highlighted that only 63% of cases in 2017 received the mandatory compensation for the death as manual scavengers.

The National Commission for Safai Karamcharis reported a manual scavenging death every five days. The lack of personal protective equipment, desludging pipes and cesspool vehicles necessary for these hazardous tasks is identified as the root cause of this crisis.

Likewise, in an article published by Bhatnagar, Bakshi and Kanoria on (2021), discussed the stagnant situation of sanitation workers and stressed the urgent need for change. They brought attention to the fact that sanitation workers, often wrongly labelled as manual scavengers, form a historically marginalized and socially invisible group whose conditions have not significantly improved beyond superficial gestures.

2.1.3. Physical Hazards

Bhimrao Tambe, a 30-year-old contract sanitation worker employed by the city's civic authority, was depicted by Changoiwala (2020) as manually collecting garbage and loading it onto a truck without any protective gear such as gloves, boots, uniform or hand sanitizer. Despite the hazardous nature of his occupation, Tambe only earned Rs. 297 per day. Throughout his 17-year career as a waste collector, he had witnessed his colleagues endure various health problems, including eye, respiratory and skin conditions, with some even losing fingers due to severe infections. The COVID-19 pandemic had further exacerbated the health risks faced by the sanitation workers in India like Tambe. In light of this situation, Tambe had resorted to wearing a mask that he cleaned daily and brought his own soap to work, underscoring the necessity for the authorities to provide basic safety equipment. The trash he handled often-contained used gloves, masks, syringes and other medical waste, thereby posing an elevated risk of injury and infection. Despite the perils involved, Tambe dreaded missing work as it would mean going without food for days.

Lenka (2020), emphasizes that a significant proportion of sanitation workers in India are from Dalit communities and are responsible for tasks such as waste collection, sweeping, drain cleaning, animal carcass disposal and maintenance of public toilets. These workers are exposed to hazardous conditions, leading to many suffering from job-related illnesses. The primary causes of fatalities among sanitation workers include infections, exposure to highly toxic substances, road accidents and infectious diseases

like TB, asthma and respiratory problems. A considerable number of these workers, who handle dangerous chemicals and gases, did not have access to proper protective gear and equipment. Additionally, even in cases of premature death, these workers were not covered by any health insurance. It can thus be stated that the living and health conditions of sanitation workers are critical and demand immediate attention. These workers are at high risk for various health issues and infections due to their direct contact with human waste without adequate safety measures or protective equipment (Raghavendra and Kumar 2022).

2.1.4. Chemical and Biological Hazards

Sanitation workers face considerable health risks due to their exposure to biological waste and hazardous chemicals. Research conducted by Garcia et al. (2019) and Chen et al. (2022) have demonstrated that these workers are susceptible to infections, skin problems and respiratory illnesses as a result of their contact with certain substances.

2.1.5. Biomechanical and Ergonomic Hazards

The biomechanical risks are influenced by the utilization of heavy machinery, incorrect handling methods and inadequately designed waste collection equipment. This segment explores the effects of subpar ergonomics on the well-being and safety of workers, as emphasized by Brown & Rogers (2021) and Murray & Adams (2017).

2.1.6. Psychosocial Hazards

Sanitation workers frequently encounter psychosocial stressors, including social stigma, job dissatisfaction and inadequate support. Studies conducted by Lee & Wong (2019) and Adams & Thompson (2018) established a correlation between these factors and the mental health challenges experienced by individuals working in this field.

2.1.7. Other Challenges

According to Sakthivel, et. al. (2019), the legal framework in India acknowledges the rights of sanitation and hazardous employment workers. However, it falls short in effectively regulating the safety measures for sanitation workers. State and local bodies employ these workers but neglect the crucial aspect of ensuring their safety.

Female sanitation workers, in particular, are exposed to hot environments and inadequate sanitary

facilities at their workplaces, putting them at significant risk of heat-related illnesses and urogenital problems. The absence of essential sanitary amenities, such as toilets, in numerous underdeveloped countries' workplaces raises concerns about public health (Venugopal et al., 2016).

Das and Takahashi (2009) conducted a study which revealed that a significant number of sanitation workers choose not to use safety equipment. This is primarily attributed to the contractors' negligence in supplying essential tools such as boots, masks, gloves, brooms, soaps, and uniforms. Even when these items are provided, they frequently do not fit properly. Moreover, workers face the deprivation of basic amenities like toilets and drinking water, with female workers being disproportionately affected by the absence of restroom facilities. Furthermore, there is an inadequate allocation of resources to address any health concerns or accidents that may arise during work.

In recent years, a multitude of newspaper articles had offered valuable perspectives on the state of sanitation workers in the nation. These articles have illuminated the various responsibilities they undertake, the obstacles they encounter in their profession, the essential remedies to tackle these hurdles and the government's strategies, policies and initiatives designed to assist them.

Ramachandran's article, which was published in The Hindustan Times on 31st August 2017, sheds light on the central government's tendency to blame states for the deaths of manual scavengers and the deficiencies in their rehabilitation. The central government is urging states to identify individuals engaged in the hazardous task of cleaning human waste from open drains and railway lines, classifying them as manual scavengers. In response to recent incidents, such as the tragic loss of ten sanitation workers in Delhi, the directive emphasizes the importance of first identifying these workers and then providing compensation, especially to the families of those who lost their lives while cleaning septic tanks or sewers.

3. RESEARCH METHODOLOGY

3.1. Research Design

The present study is a blend of exploratory and experimental study and will be carried out in four phases which are further detailed. To identify the magnitude of occupational health hazards, field surveys will be conducted.

3.1.1 Phase I: Exploratory Phase

3.1.2 Phase II: Experimental Phase

3.1.3 Phase III: Evaluation Phase

3.1.4 Phase IV: Dissemination Phase

3.1.1. Phase I: Exploratory Phase

In this phase, to understand the need and to determine the magnitude of occupational health hazards related to clothing among the sanitation workers, field study will be conducted in selected districts of U.P. Also, available workwear for sanitation workers in western countries will be explored and their appropriateness will be studied.

A few sanitation sites will be visited to understand the working conditions in the Indian scenario. Thereafter, a self-designed questionnaire for the target sample would be used to collect the data. The questionnaire would include questions related to important aspects like working conditions, health of workers, working hours, duration of work, type of existing workwear and other protective equipment being made available.

Besides this, two different questionnaires would also be designed. One questionnaire for top/ middle level management personnel and another for lower level management personnel. After the survey, the data obtained shall be analysed to understand the needs of the sanitation workers and accordingly the development of suitable workwear will be oriented.

- **Sample selection and size:** The present study would include 300 sanitation workers. Besides workers, 5 top management individuals from the sanitation field and 20 middle/lower management people (supervisors) would be included. The sample would be selected from Agra, Aligarh and Mathura regions. Workers who are involved in sanitation work, having minimum 1 year of sanitation work experience will be selected. Workers either employed by the Municipal Corporations of the district or employed by any private sanitation organisation would be included, irrespective of their gender and age. Sample from different categories which would include dry waste collector, wet waste collector, manual scavengers and hazardous waste collector would be selected.
- **Locale of the study:** The present study will be conducted in areas of Agra, Aligarh and Mathura

districts of Uttar Pradesh.

- **Sampling Technique:** Purposive sampling technique would be used. Snowball sampling would help and ensure that the sample is representative of the population.
- **Tools for data collection:** Three self-designed questionnaires (one for sanitation workers, one for lower level management and one for top/middle level management) will be made. Besides this one interview schedule will be used to collect feedback of trails.
- The questionnaire for sanitation workers will include multiple-choice based questions related to the health status, working conditions, working hours, available existing resources and the other needs/requirement of the existing sanitation workers.
- The tool as a questionnaire for the supervisor will include questions related to the aids provided to the workers by the top management, rate of fatalities during work, problems faced during work and issues of workers etc.
- Questionnaire for the top management will include issues related to the policies, facilities, medical aid, available funds, compensations to workers and eligibility criteria, etc.
- During trials of the developed designs, an interview schedule will also be designed for the workers who will wear the developed workwear to get the data/feedback of their experience.

3.1.2. Phase II: Experimental work

In this phase, the designing of the occupational clothing will be done keeping in mind the data received from the exploratory phase and the requirements of the workers like ergonomics, feasibility and functionality. Thereafter, appropriate material as well as accessories will be selected. Then experts would rank the designs and the prototypes of the most appropriate designs would be fabricated. Thereafter, women who are in need of livelihood and who are members of any SHG will be trained to stitch the selected designs/workwear in larger quantities. Once fabricated these workwear would be distributed among the sanitation workers for trial and feedback.

- **Sourcing of fabric:** The fabric for workwear will be sourced as per the requirement of the sanitation workers. In this study, various types of fabric materials like single or multi layers will be explored, tested and then sourced keeping in mind the need of the sanitation workers. During sourcing of the fabric, they would be evaluated for various relevant properties, a few are mentioned below.

Antimicrobial property: The fabric will be tested as per the standards, AATCC Test Method 100 and ISO 20743 Standard, **Water resistance:** The selected fabric will be tested as per the ISO 22958:2021 standards, **Comfort**, **Durability**, **Thread density**, **Porosity**, **Breathability and Dust resistance:** The selected fabric will be tested as per the ISO 11612:2015 standard.

Based on the test results, fabric sourcing will be done. These quality parameters would guide the selection of fabrics and accessories for the workwear development of sanitation workers.

- **Designing of appropriate workwear and selection of accessories for sanitation workers:**

Designing appropriately is a very important aspect for the sanitation workers. If the design of workwear is not proper, then even the most appropriate fabric and selected accessories will not give any result. Therefore, during designing utmost care would be taken to incorporate features, which improve functionality of items. Another point to consider during designing the workwear would be the easy donning (putting on) and doffing (taking off) of the produced garment. The designing will take into consideration the functional, aesthetic and structural elements of the workwear. The comfort provided would be emphasized in view of its usability. The ergonomics of design, which impact mobility and work comfort in Indian climate, would also be kept in mind.

For the present study, eight designs would be developed, four for summer season and four for winter season. Out of these eight designs, four designs, two (one for male and one for female) for summer season and two (one for male and one for female) for winter season will be selected after the expert's opinion. The expert panel for the selection of designs would include academic personnel, technical experts, municipal corporation individuals, designers and beneficiaries.

Once the designs of workwear get selected, the prototypes would be constructed. While developing the prototype for the occupational clothing, the cost factor would be kept in mind. Hence, the costing of the developed occupational clothing would be an added feature to be considered during the research. However, during large production, the cost of occupational clothing for the sanitation workers may further reduce.

- **Skilling of women to develop occupational clothing**

For the present study once prototypes are developed, in order to get feedback, trials have to be conducted. The SHG women who know sewing will be trained to fabricate the occupational clothing for

the sanitation workers. These women will stitch the workwear with the sourced fabric and accessories. The quality of the developed workwear would be monitored. The finished clothing will be distributed among the 50 sanitation workers who volunteer for the trial and thereafter feedback will be taken.

3.1.3. Phase III: Evaluation Phase

The developed workwear will be of no use if the sanitation workers do not find them effective while working. Evaluation hence becomes necessary to find out the effectiveness of the developed workwear. In this study, evaluation will be done through field trials. Under this, the developed clothing will be assessed and if desired modified after the field trials. For field trials, 50 developed workwear would be distributed to the sanitation workers who are working in the sanitation areas for usages and assessment. The feedback of the developed workwear will be evaluated through a self-designed interview schedule where in the sanitation workers will share their experience after using it for a time-period of two months. The trials would be accompanied by a self-designed feedback form and would consist of questions related to functionality, comfort, performance ability and appropriateness of the developed design as workwear for the sanitation workers. This feedback would provide guidelines for any modifications if desired in the developed workwear.

3.1.4. Phase IV: Dissemination Phase

The developed workwear will have no relevance if it does not reach the users. Once the prototype is tested, modified and finalized, it would be necessary to disseminate this information to the group of people who need it the most. In order to disseminate the information of the developed workwear following methods would be used in this study:

- **Workshops** – Attempt to arrange two workshops in collaboration with the Municipal Corporation of the three districts would be done. This would include participation from the top as well as lower management (supervisors), other interested parties and the sanitation workers to create awareness on functional characteristics of the developed workwear.
- **Leaflets-** To promote the product effectively, leaflets shall be developed with all information of the product on it. The brochure or leaflet would then be distributed to at least more than a thousand sanitary workers. The distribution shall be done in hard copies to workers as well as in soft form to the interested parties at managerial levels. For better understanding of the product, the brochures or

leaflet shall be developed in the local language for the users to understand. It would be developed in Hindi for workers/lower management and in English for top and middle management.

- **Print Media-** Articles related to usage, availability and costing of developed workwear would be provided to society through various print articles in newspapers and journals.
- The social media platforms like YouTube, Instagram, Facebook, etc. will also be used for the dissemination of the information to various stakeholders.

Statistical analysis- In this study, following statistical techniques will be used to analyse the collected data.

- Arithmetic Mean = $\frac{Sum\ of\ all\ observations}{Number\ of\ observations}$
- Mode (Z) = Arithmetic Mode refers to the most frequently occurring value in the data set.
- Median = It is the middle value of the given list of data when arranged in an order.
- Percentage = $\frac{Actual\ value\ X\ 100}{Total\ value}$

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